SECTION 1520
SANITARY SEWER

1520-1 DESCRIPTION

Provide sanitary sewers suitable for transporting sewage.

1520-2 MATERIALS

Refer to Division 10.

Item	Section
Sanitary Sewer Pipe and Fittings	1034

Use any pipe specified under Section 1034 except where a particular type pipe is specified in the plans or required by environmental regulations or Departmental policy. Verify the pipe is appropriate for the test pressure of the system and the external loading.

Use ductile iron fittings on pressurized (force main) pipelines 4" or larger.

Use screw type plastic or brass clean-out covers.

Use #12 AWG solid-copper wire with green insulation for the utility locator wires.

Use 2" plastic marking tape colored green with “Caution Sewer Line,” or similar wording, permanently printed at 36" centers.

1520-3 CONSTRUCTION METHODS

Apply Section 1505 for excavation, trenching, pipe laying and backfill to sanitary sewer installation.

Assemble pipe in accordance with the recommendations of the manufacturer.

Install PVC pipe in accordance with approved bedding methods.

Install vitrified clay sewer pipe in accordance with ASTM C12.

Install 4" minimum diameter sanitary sewer clean-outs flush with finished grade on 4" and 6" service lines. Provide clean-outs at the right-of-way line and at changes in direction. Do not locate clean-outs within the roadway pavement or shoulders. Provide clean-outs no more than 50 ft apart when beyond the roadway shoulders.

Use ductile iron pipe for sewers with 10% or greater slope.

Install sewer lines entering manholes with the crown at or higher than the sewer line leaving the manhole.

Install small diameter pipe (4" or less) under existing pavement by a trenchless method at no additional compensation.

(A) Gravity Sanitary Sewer

Construct gravity sanitary sewers in conformance with *NCDENR Gravity Sewer Minimum Design Criteria*.

(1) Pipe Installation

Use fittings or saddles to connect service lines to the sewer main.

Maintain sewer flow at all times. Use temporary diversions or pumping to maintain flow when connecting proposed sewers to existing sewers. Use engineered temporary pumping systems capable of handling full pipe flow. Use pumping systems with automatic reliable operation or constantly tended manual operation.

(2) Testing

Perform tests on newly installed sewers and altered sewers before placing into service. Provide all equipment, piping, controls, pumps, water and safety devices necessary for performing the tests.

Test all gravity sewer lines for leakage using one of the following methods:

(a) Infiltration

For sewer lines greater than 3 ft below groundwater, measure the amount of water infiltrating into the pipeline between manholes in at least 24 hours. Repair leaks or replace piping when the rate of infiltration exceeds the following equation:

$$\mathbf{W} = 0.000789LD$$

Where:

W = maximum allowable leakage in gallons per hour
L = length of pipeline tested, in feet
D = nominal diameter of the pipe, in inches

(b) Exfiltration

For sewer lines above groundwater, perform an exfiltration test on the pipeline between manholes. Repair leaks or replace piping when the rate of exfiltration exceeds maximum allowable leakage calculated in Subarticle 1520-3(A)(2)(a).

The exfiltration test shall consist of securely plugging the pipe at the lower manhole and filling the pipeline with water. Allow the water to set for 24 hours in clay or concrete pipes. Raise the water level in the upstream manhole to 3 ft above the top of pipe. After 4 hours, measure the amount of water required to bring the water level back to the level at the start of the test and record the time.

Perform exfiltration tests through a series of manhole to manhole segments to limit the length of pipe tested to between 300 ft and 1,500 ft. Shorter sections may be tested with longer test times. No additional leakage allowance for manholes permitted.

(c) Air Test

Instead of hydrostatic testing, sewer lines 24" in diameter or smaller may be air tested in accordance with ASTM C828, ASTM C924 and the following. Securely plug the sewer pipe at the manholes. Fill the pipe with air to 4.0 psi and hold this pressure for 5 minutes. Reduce the pressure to 3.5 psi. Measure the time for the pressure to drop 1.0 psi to the new pressure of 2.5 psi. Exceed the minimum test time in Table 1520-1 for the appropriate nominal pipe diameter.

TABLE 1520-1
AIR TEST TIME

Pipe Size (Inches)	Test Time (Minutes/100 ft)	Pipe Size (Inches)	Test Time (Minutes/100 ft)
8	1.2	18	2.4
10	1.5	21	3.0
12	1.8	24	3.6

(d) Visual Inspection

Visually inspect sewer lines larger than 24" from the inside using approved cameras. Correct any leakage, rolled gaskets or defects.

(e) Line and Grade

Test all sewers for straight alignment by lamping or using a laser.

(f) Deflection Testing

Perform deflection tests on all flexible pipes. Conduct the test after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system. As an alternative to waiting 30 days to permit stabilization of the soil-pipe system, provide certified soil testing verifying the backfill of the trench has been compacted to at least 95% maximum density.

No pipe shall exceed a deflection of 5%. If deflection exceeds 5%, relay the pipe.

The rigid ball or nine-point mandrel used for the deflection test shall have a diameter not less than 95% of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM, to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D2122. The test shall be performed without mechanical pulling devices.

(B) Force Main Sanitary Sewer

Construct force main sewers in conformance with *NCDENR Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains.*

(1) Installation

Install lines with 36" to 42" of cover to finished grade unless otherwise directed or approved. Install lines with greater cover for short distances to accommodate utility controls, to make tie-ins to existing facilities, to eliminate high points in the pipeline or to provide clearance from existing or proposed utilities, drainage, other obstacles or actual field conditions.

Provide automatic air release valves at all high points.

(2) Testing

Perform pressure and leakage tests on newly installed force mains and altered sewers before placing such pipelines into service. Provide all equipment, piping, controls, pumps, water and safety devices necessary for performing the tests and sterilization.

Test all new sewer force mains with clean water at 200 ± 5 psi for a 2 hour duration. Vent all high points and expel all air. Provide certified results demonstrating leakage less than:

$$\mathbf{W} = 0.000106LD$$

Where:

W = allowable leakage in gallons per hour
L = length of pipeline tested, in feet
D = nominal diameter of the pipe, in inches

Repair leaks using approved methods or replace pipe, controls or appurtenances as necessary to reduce leakage. Additionally, repair any leaks that are visible after 2 hours duration.

1520-4 MEASUREMENT AND PAYMENT

__" *Sanitary Gravity Sewer* and __" *Force Main Sewer* will be measured from end to end in place with no deduction for length through manholes, valves or fittings and paid per linear foot for the appropriate size. Where two different sizes enter or go from a manhole, each size will be measured to the center of the manhole. Unless otherwise shown in the plans, branch connections, ells or other fixtures will be included in the length measurement.

Sanitary Sewer Clean-Out will be measured and paid per each. No measurement or payment of service lines will be made.

Payment will be made under:

Pay Item	Pay Unit
__" Sanitary Gravity Sewer	Linear Foot
__" Force Main Sewer	Linear Foot
Sanitary Sewer Clean-Out	Each

SECTION 1525
UTILITY MANHOLES

1525-1 DESCRIPTION

Provide utility manholes on water and sanitary sewer lines.

1525-2 MATERIALS.

Refer to Division 10.

Item	Section
Brick	1040-1
Concrete Block	1040-2
Curing Agents	1026
Gray Iron Castings	1074-7(B)
Mortar	1040-8
Portland Cement Concrete	1000
Precast Concrete Units	1077
Reinforcing Steel	1070
Select Material	1016
Steps	1074-8
Structural Steel	1072

Use precast concrete manholes with monolithic bottoms which conform to ASTM C478, AASHTO M 199 and are as shown in the plans or in *Roadway Standard Drawings*. Use ASTM C443 gaskets or AASHTO M 198 flexible sealants for joints between precast manhole sections. Use resilient connectors for piping conforming to ASTM C923. Use ASTM A48, Class 35 cast iron or Grade 60 steel reinforcement steps with polypropylene plastic coating.

Use manhole frames and covers made of cast iron conforming to ASTM A48 Class 35, which are traffic bearing, have machined contact surfaces and are sized as shown. Use covers with two 1" diameter air vents for vented manholes and use solid, non-vented covers with gaskets for watertight installation. Use covers with “Sanitary Sewer” or “Water” cast in large letters as appropriate for the type of utility.

Use an approved, nonshrink cement grout. Contact Materials and Tests Unit for a list of approved packaged grouts.

1525-3 CONSTRUCTION METHODS

Apply Section 1505 for excavation, trenching, pipe laying and backfill.

Make connections of pipe to manholes in cored or precast holes using a resilient connector. Use horseshoe type holes only when approved. For horseshoe type holes wrap the pipe with a butyl rubber gasket and fill the space between the pipe and manhole with a non-shrinking grout.

Provide an outside drop assembly on manholes for sewer pipes entering with 2.5 ft or more vertical drop. Inside drop assemblies may be used for connections to existing manholes when the drop exceeds 5 ft and the manhole diameter is greater than 4 ft.